1.6 Downward adjustments and FBM wrap-up

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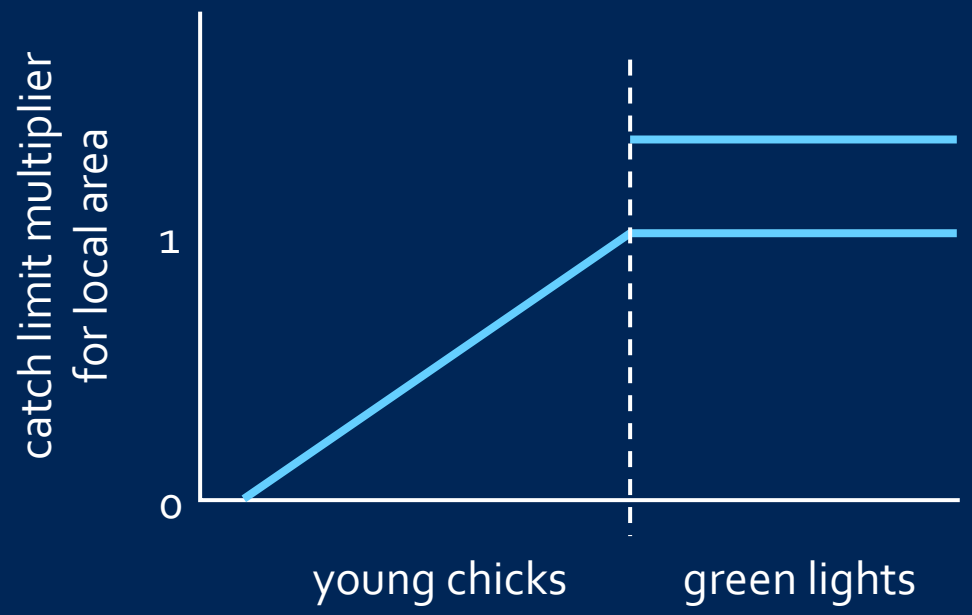
Southwest Fisheries Science Center
Antarctic Ecosystem Research Division

TOR QUESTIONS: 5, 6



1.6 Wrap-up

1.5 Adjust up

1.4 Base catch limit

1.6 Adjust down

1.2 & 1.3 Background

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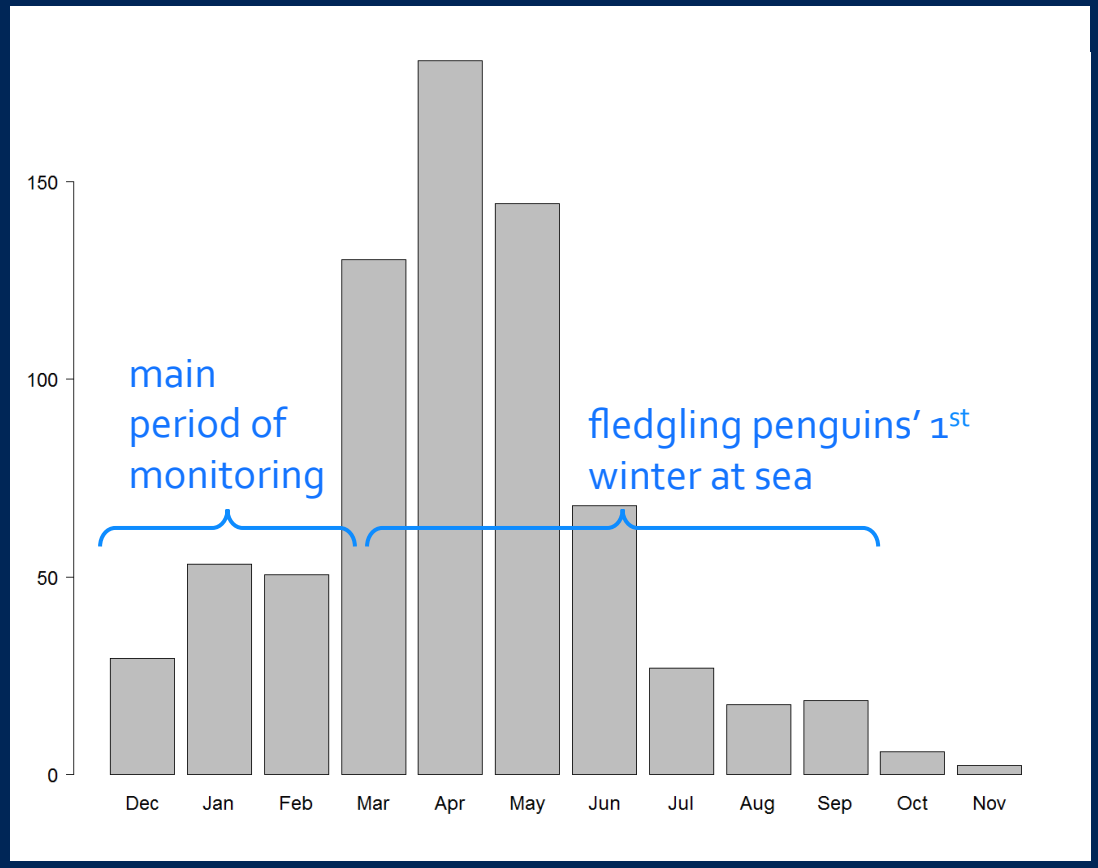
Adjust down

Need a leading indicator of predator success

Total catch (kt, 2009-2015)



HINKE ET AL. (2007)

- Winter conditions drive penguin trends
- Krill availability has "disproportionate effects" on survival of juvenile birds

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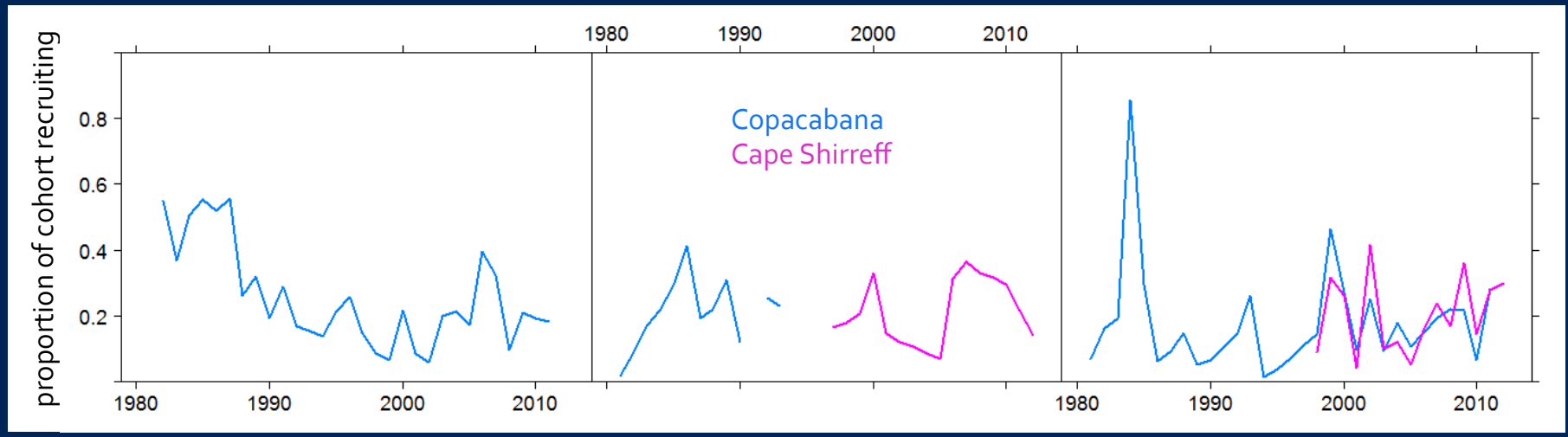
Recruitment





Problem: predict relative cohort strength from summer monitoring data
Approach: link band re-sights with observations on breeding phenology

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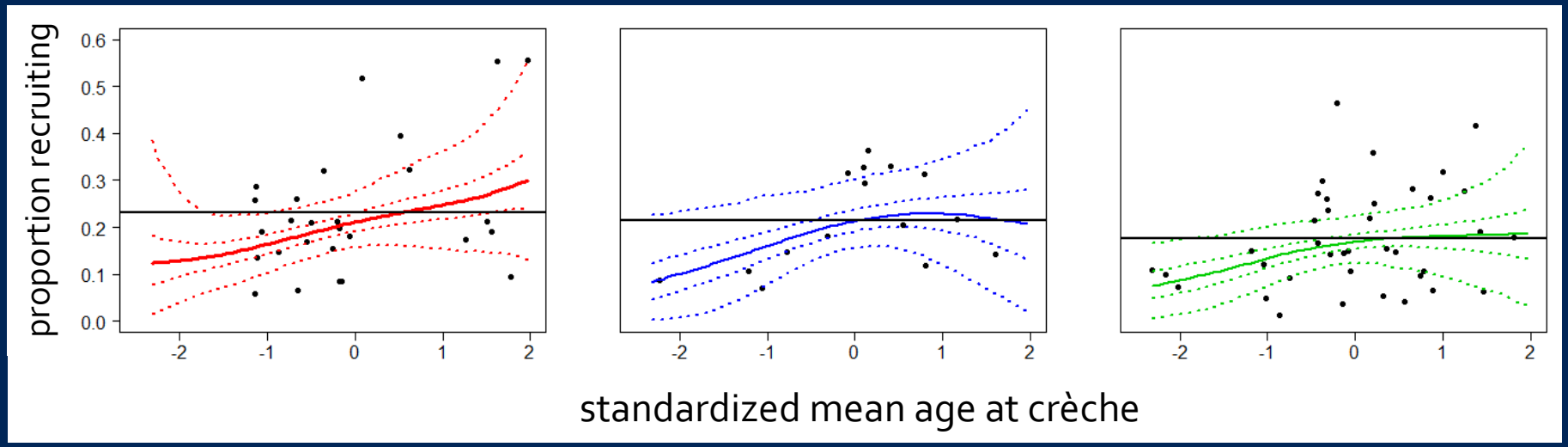
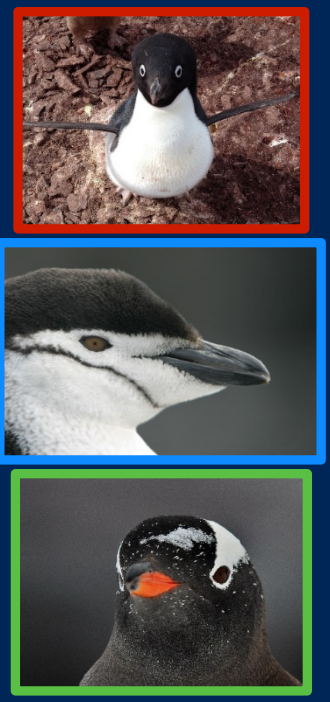
Rules of thumb

- Pr(cohort strength < mean) > 0.75 when std mean age at crèche < -1
- Pr(cohort strength < mean) > 0.95 when std mean age at crèche < -2





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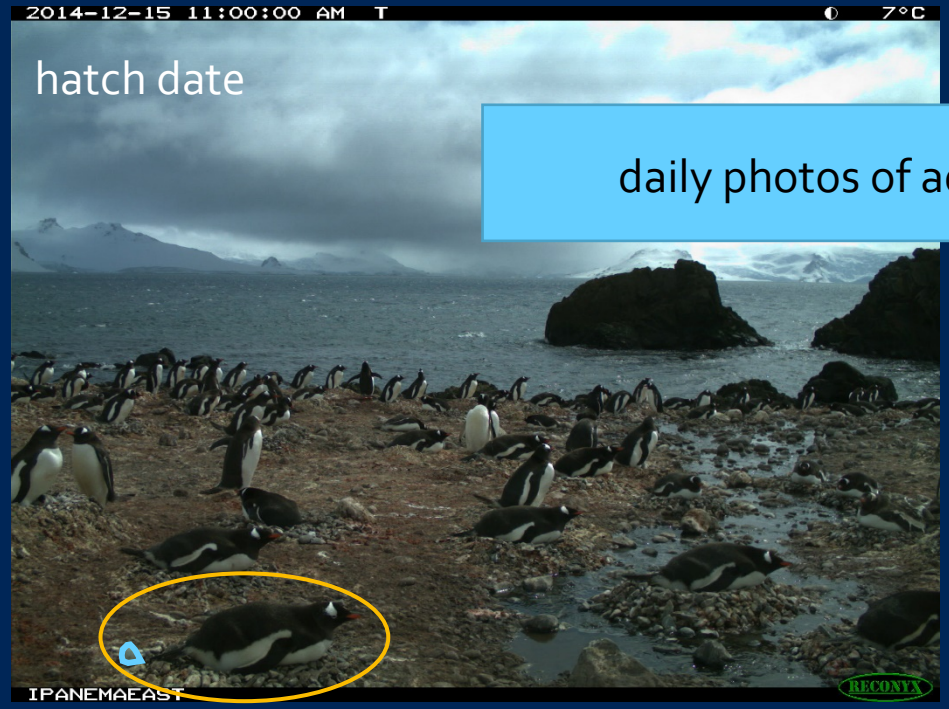
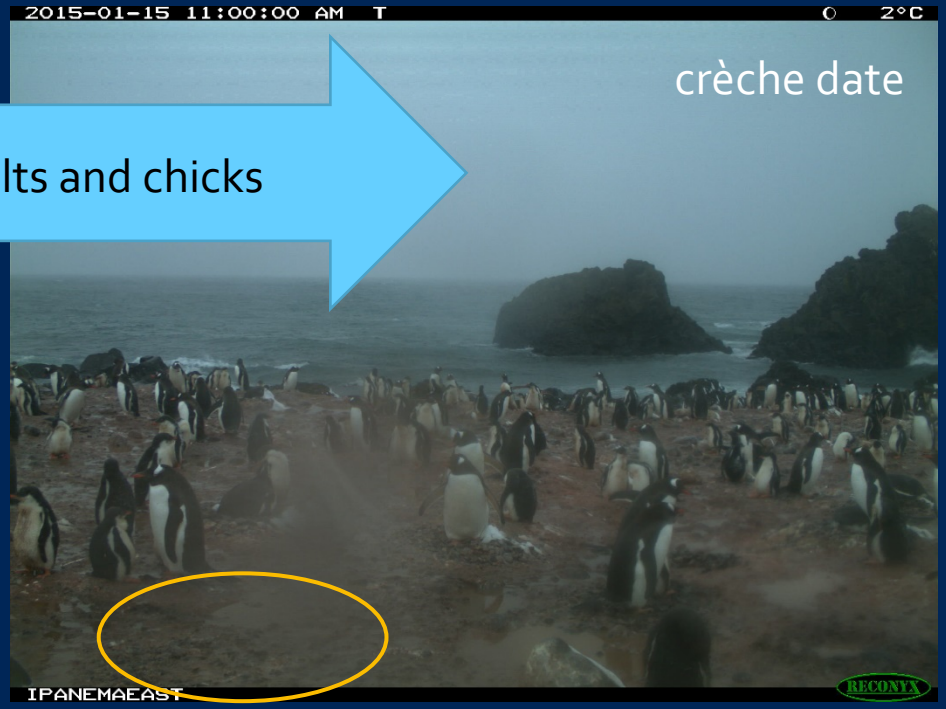
Age at crèche is tech-observable

age at crèche = 15 Jan – 15 Dec = 31 d



daily photos of adults and chicks



egg shell and occupied nest

empty nest (adults and chicks observed previous day)

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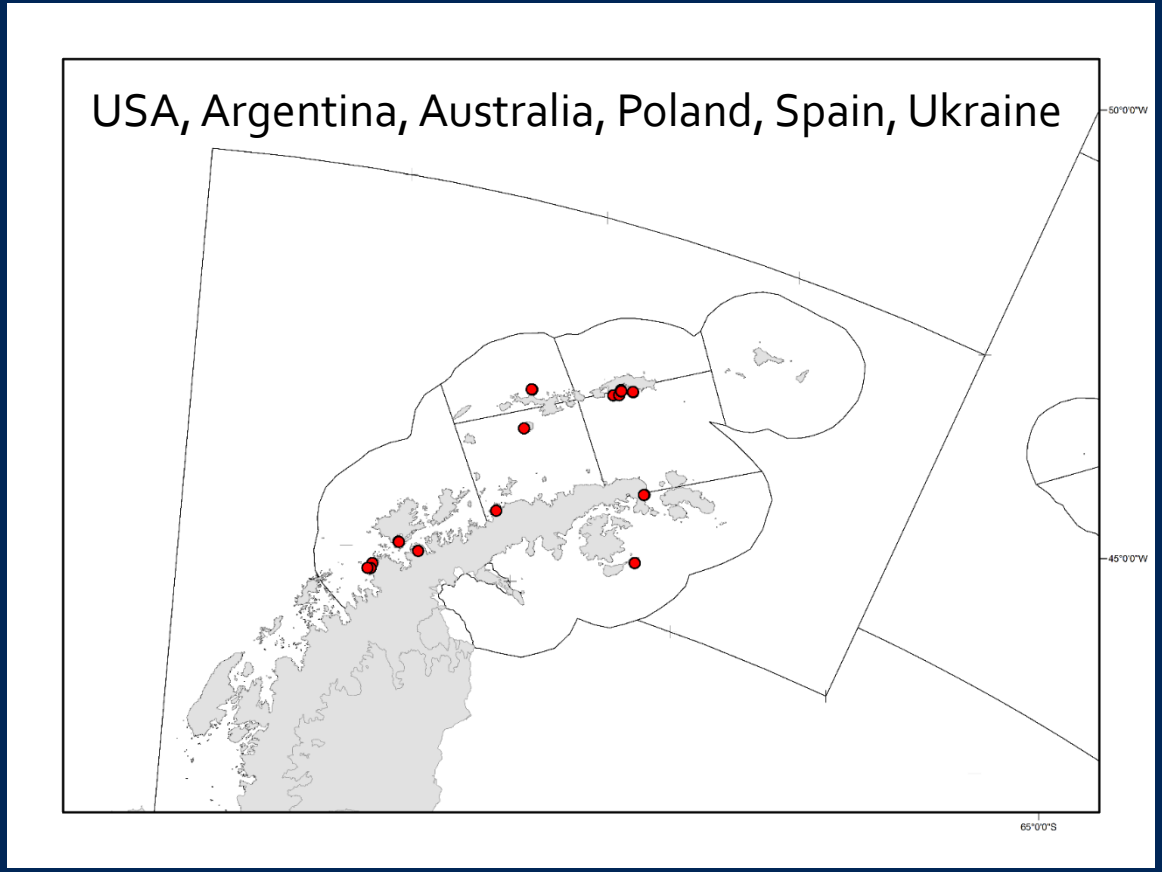
The CEMP camera network



- 18 cameras on Adélies at five sites
- 13 cameras on chinstraps at five sites
- 22 cameras on gentoos at six sites
- ~ 10 nests observed per camera

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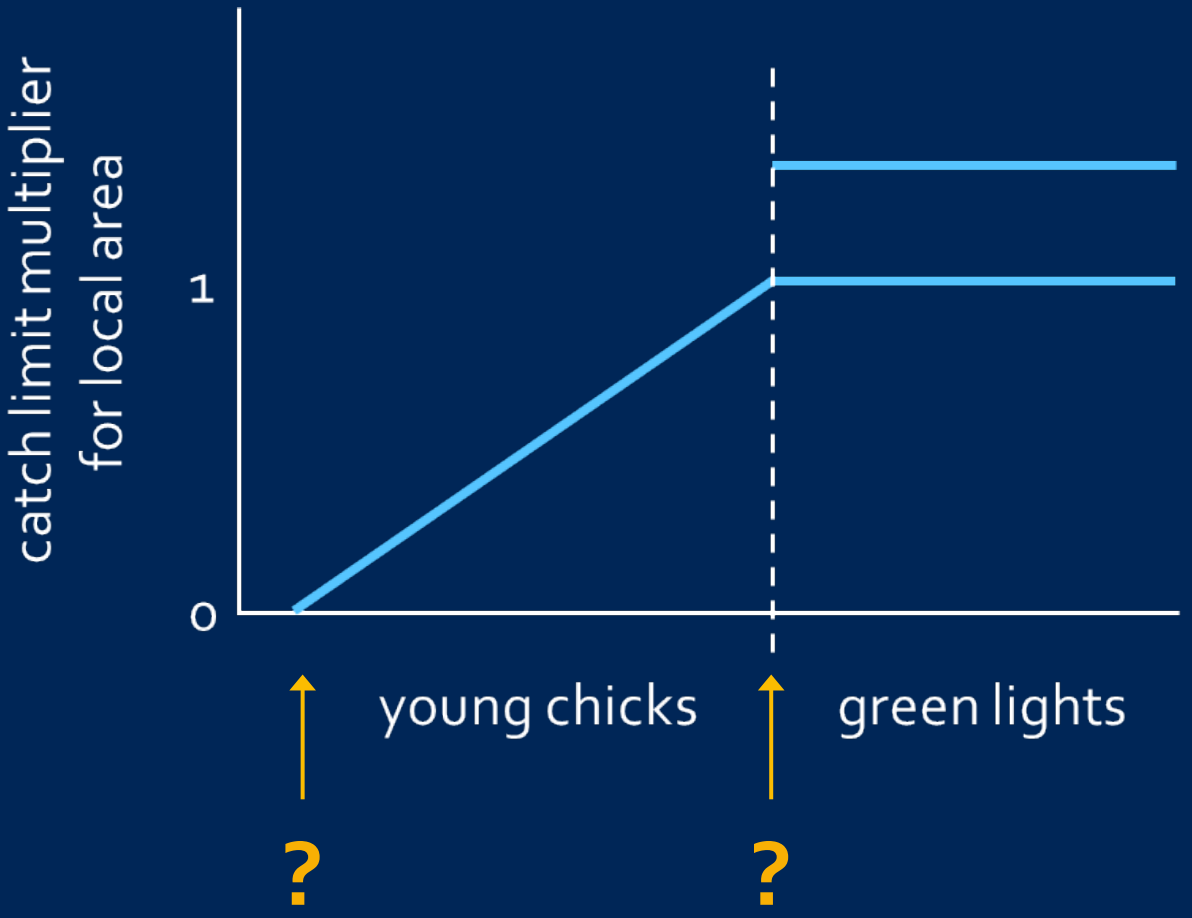

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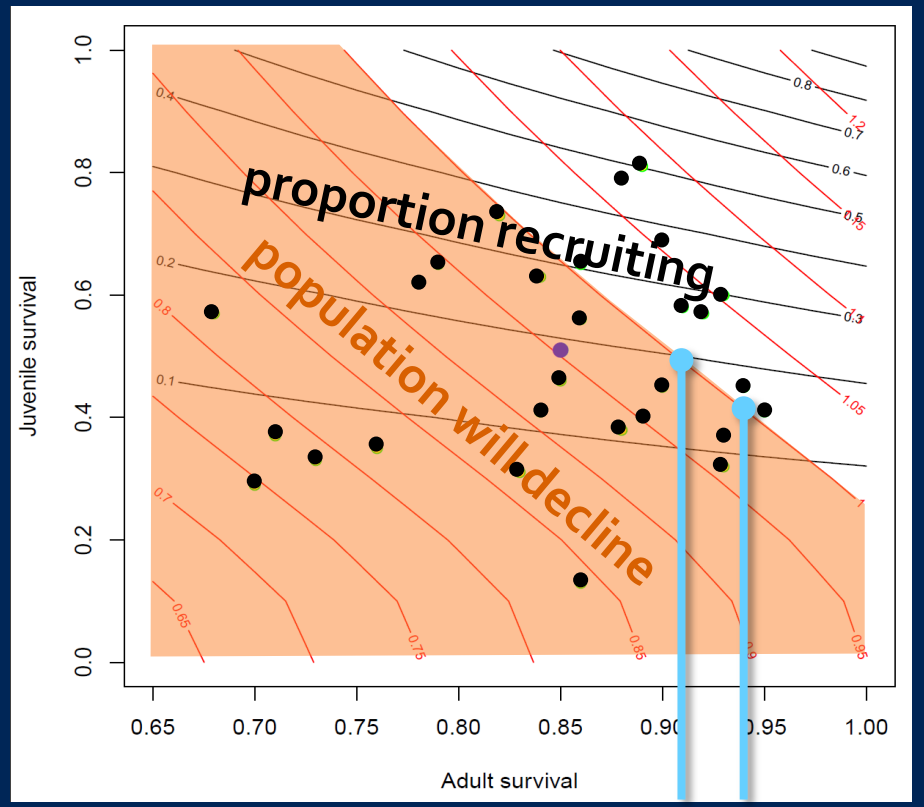
“Critical values” for downward adjustment

1. start to decrease catch when Pr(recruitment cannot prevent population decline even when adult survival is very high) > 0.5
2. stop fishing when Pr(recruitment cannot prevent population decline even when almost all adults survive) > 0.5



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penguin model adapted from Hinke et al. (in review)

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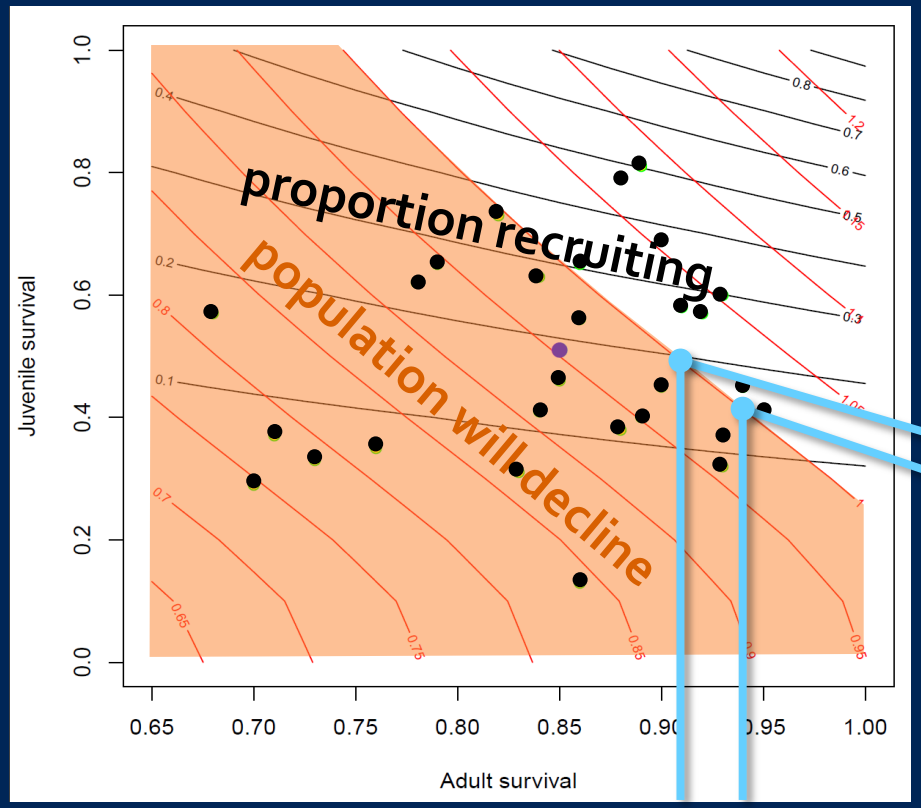
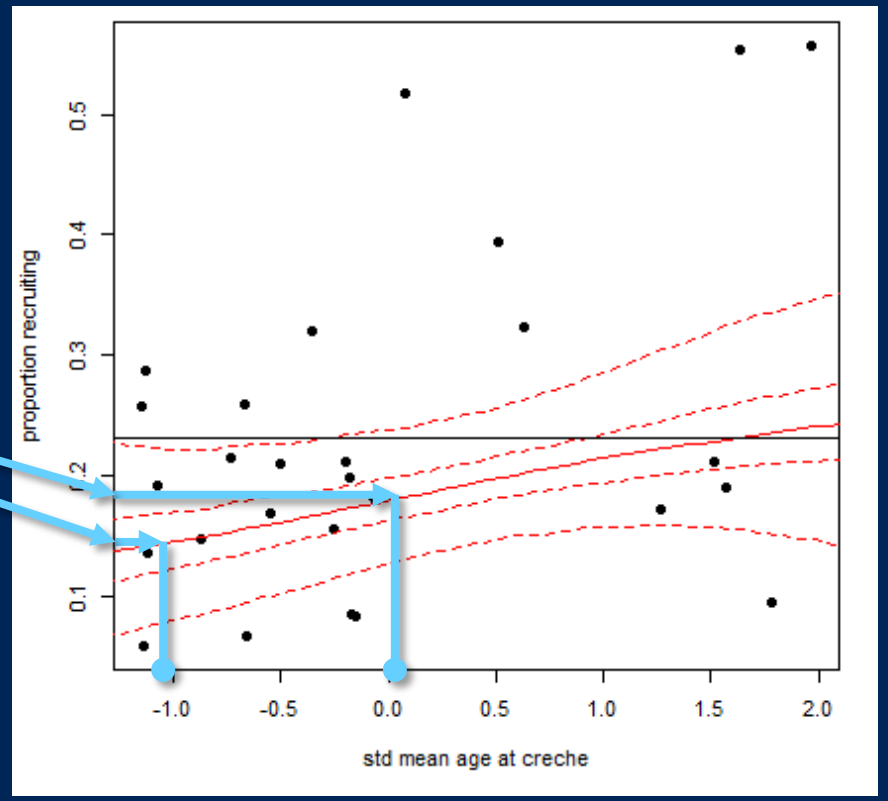
Critical values contd.





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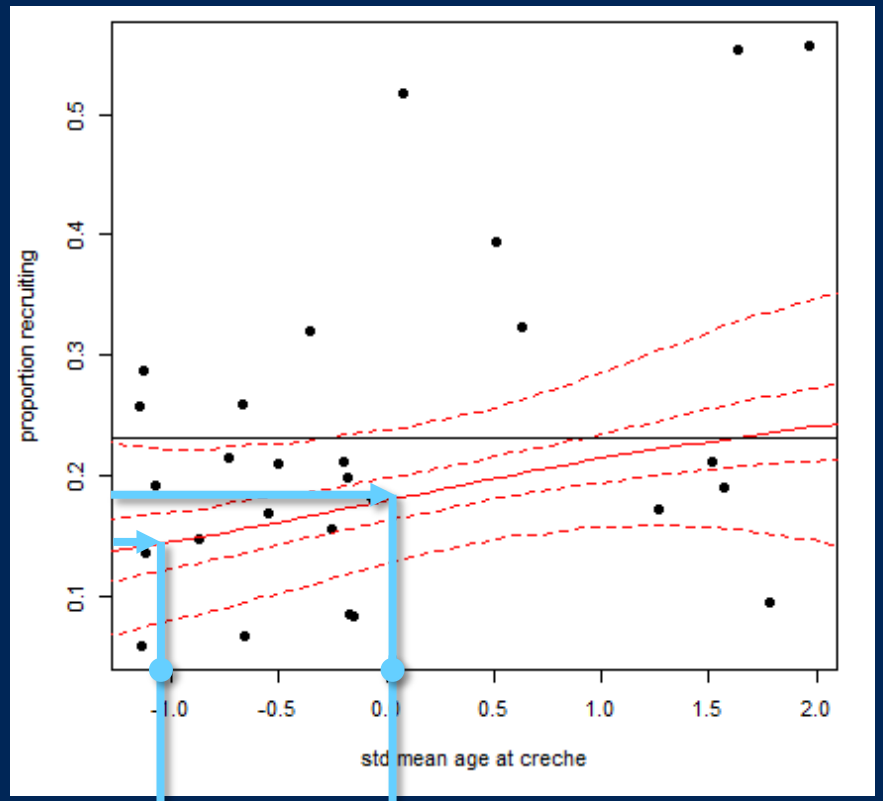
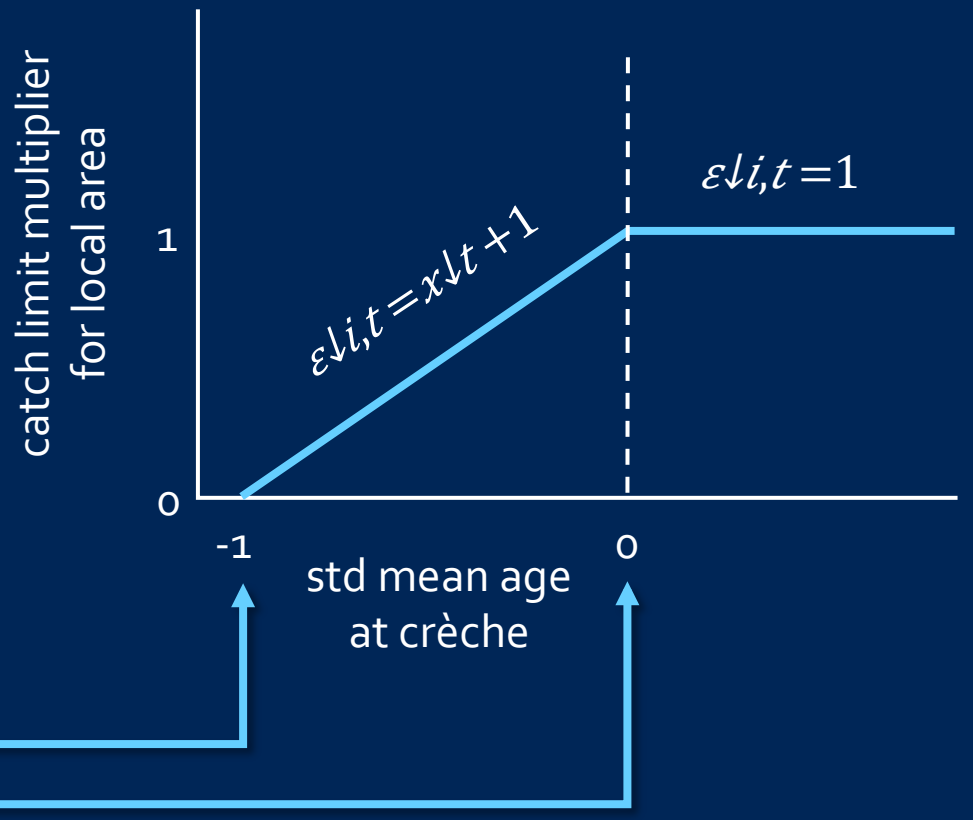
Critical values contd.





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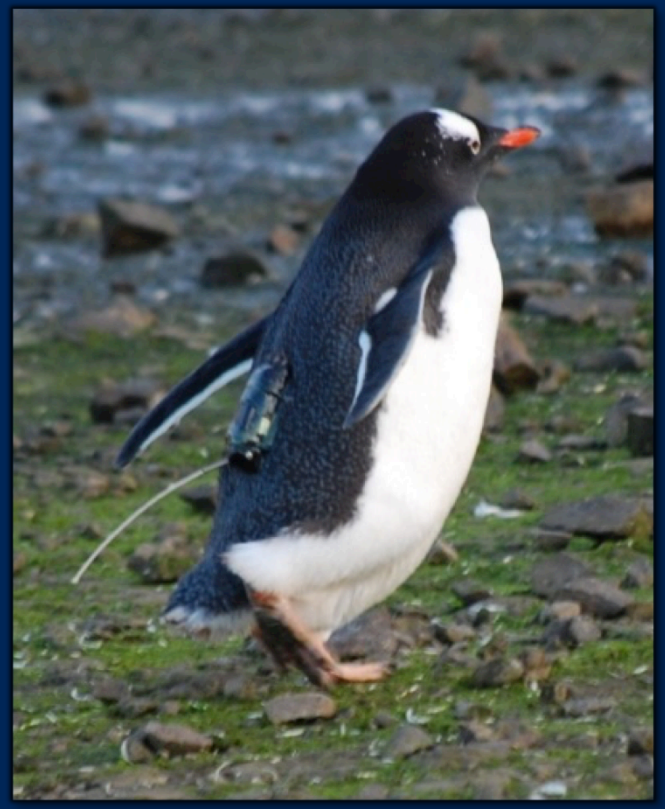
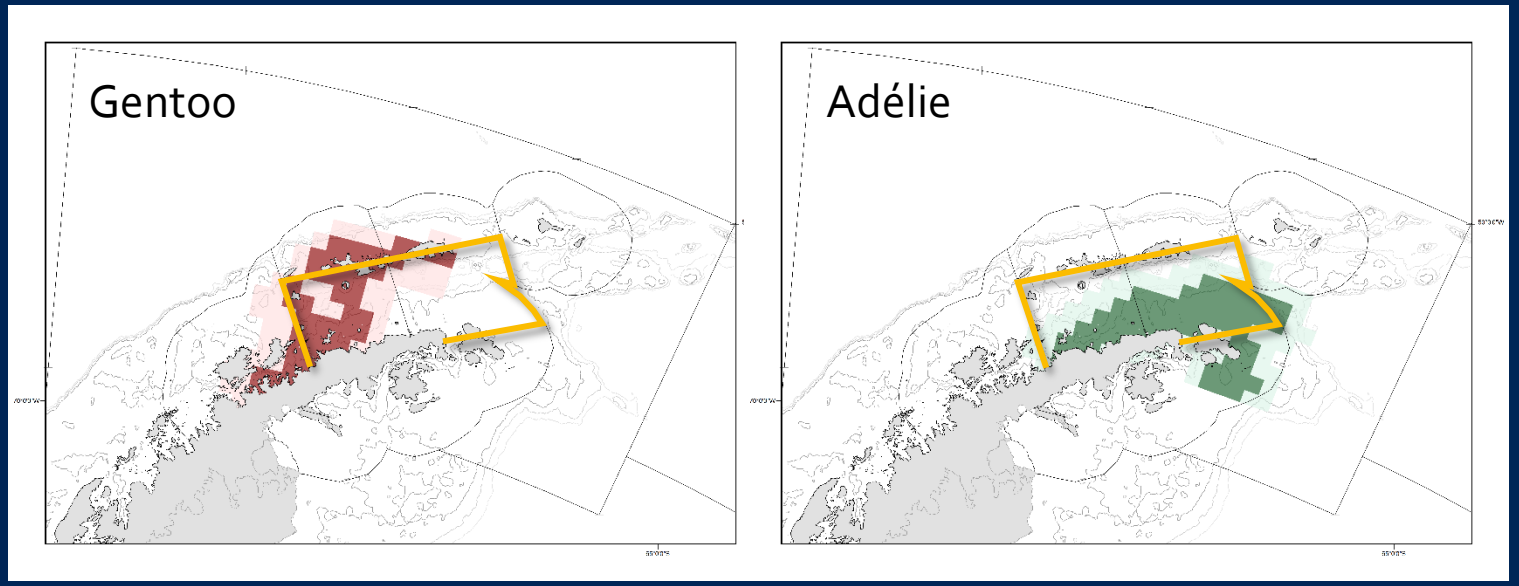
Multiple species and local areas





- one adjustment rule for each species foraging in local area – select minimum catch limit multiplier
- different adjustment rules for different local areas

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Other cool stuff in the works

- Multi-nation, multi-site, multi-species winter-tracking study
- Re-tool ecosystem model and evaluate FBM concept
- Better mark-recapture techniques to continue long-term studies of penguin demography

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Answers to TOR questions

5. Using a penguin dynamics model to identify reference points that are appropriate for achieving CCAMLR's ecosystem objectives

6. Using leading indicators of penguin performance as the basis for tactical decision making

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Wrap up

Summary

- Regional catch limit for krill fishery set using single-species assessment and decision rules
- Regional catch limit subdivided among local areas based on consensus tolerance for risk
- Ecosystem decision rules ultimately determine local area catch limits
  - Upward adjustments based on observations that are trailing indicators of summer performance
  - Downward adjustments based on observations that are leading indicators of cohort strength

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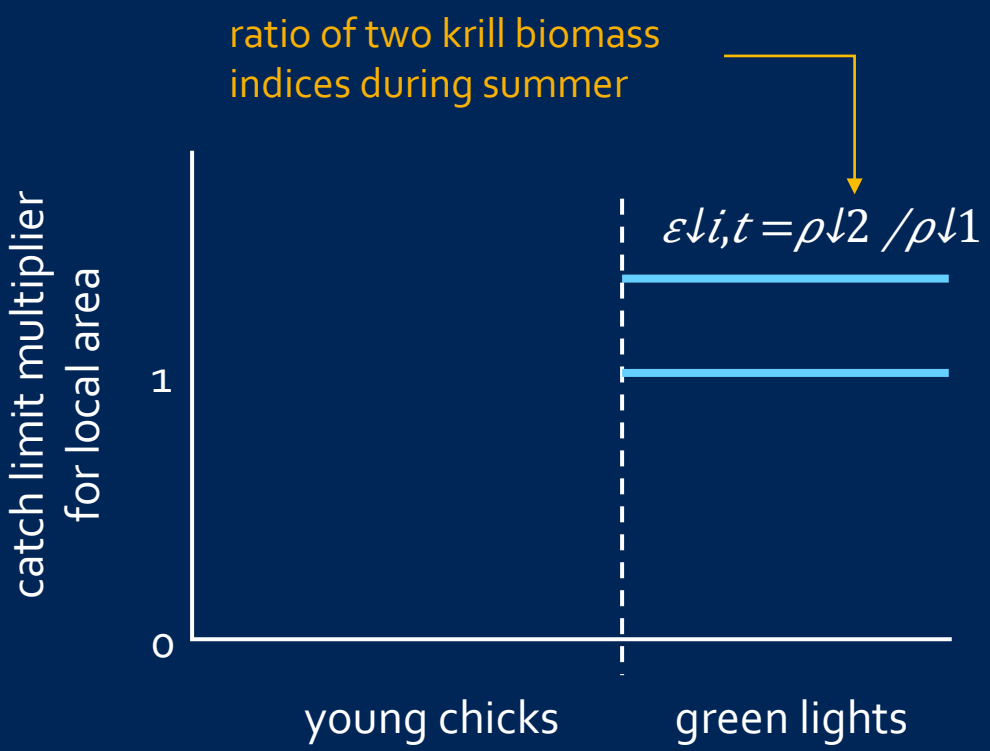
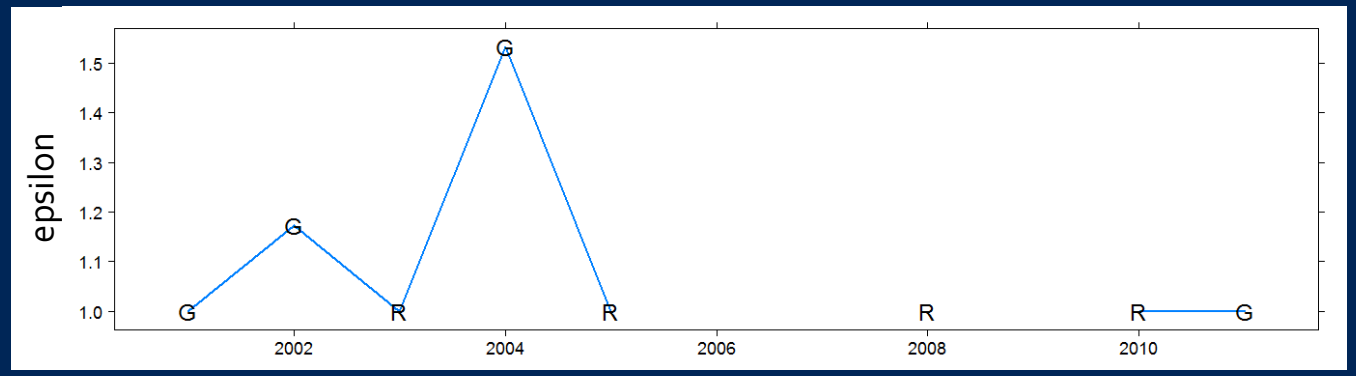
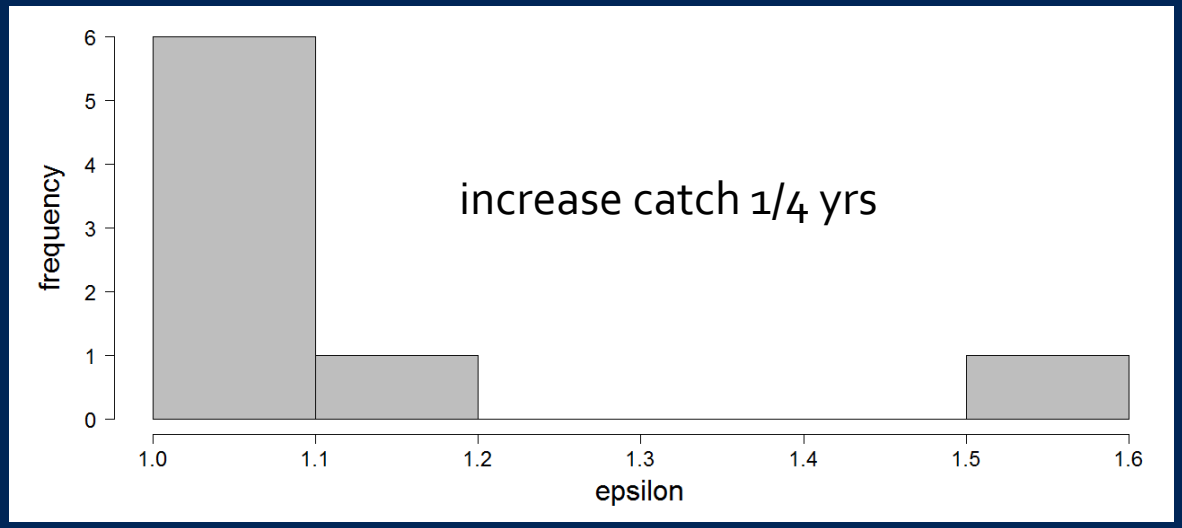
Retrospective analysis 1



R: ≥ 1 red light G: all green lights





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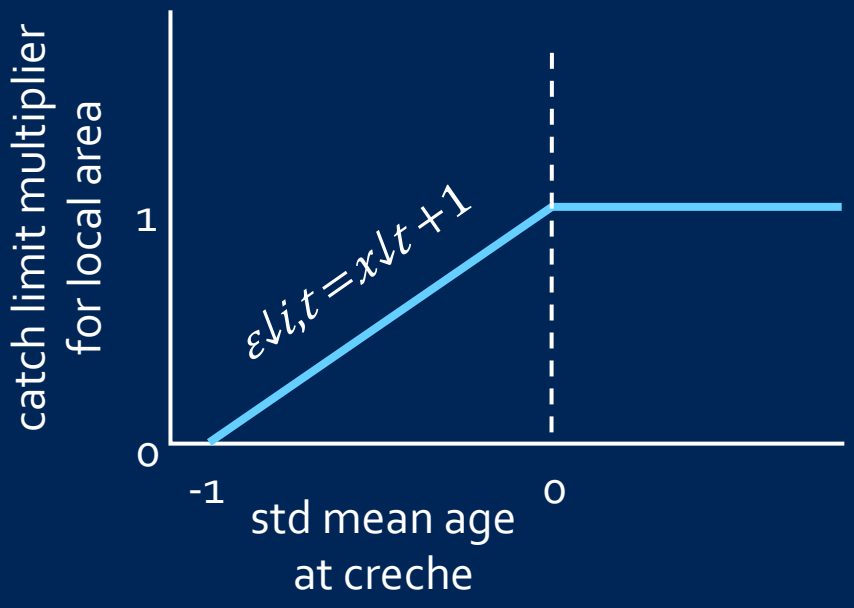
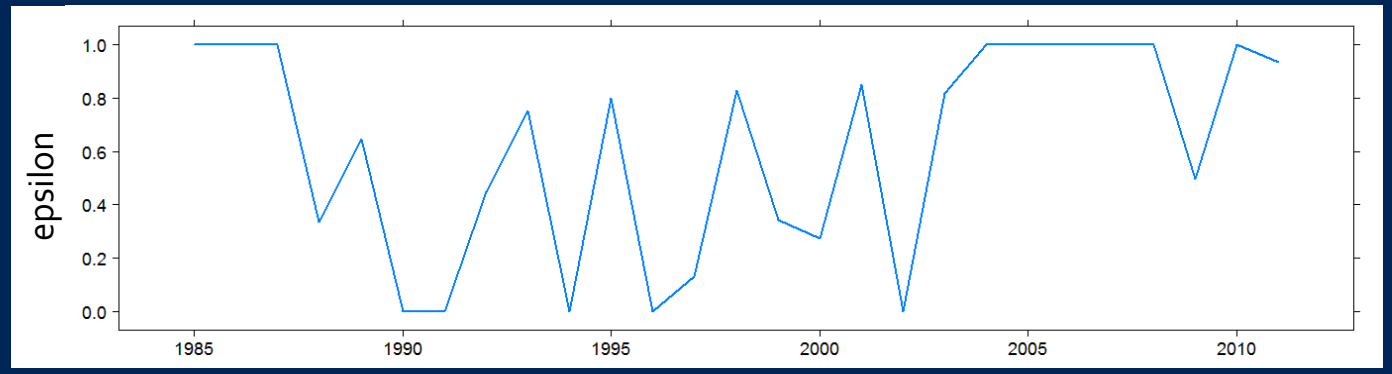
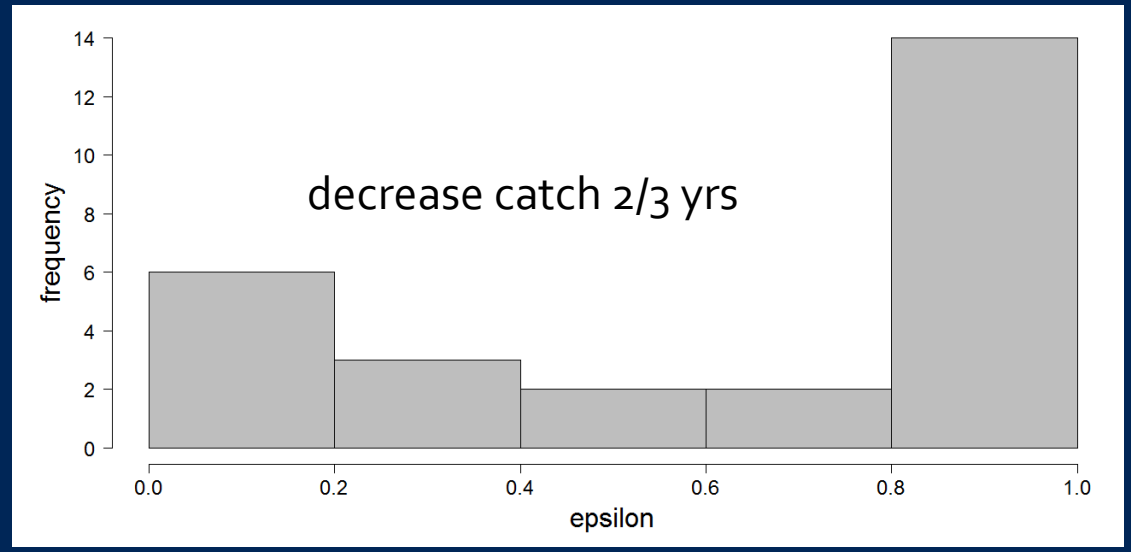
Retrospective analysis 2







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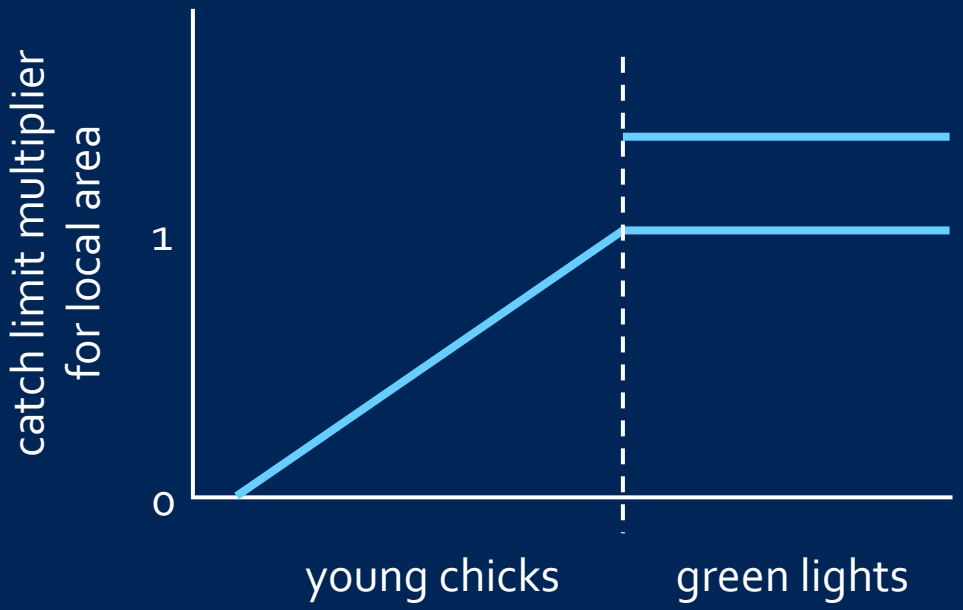
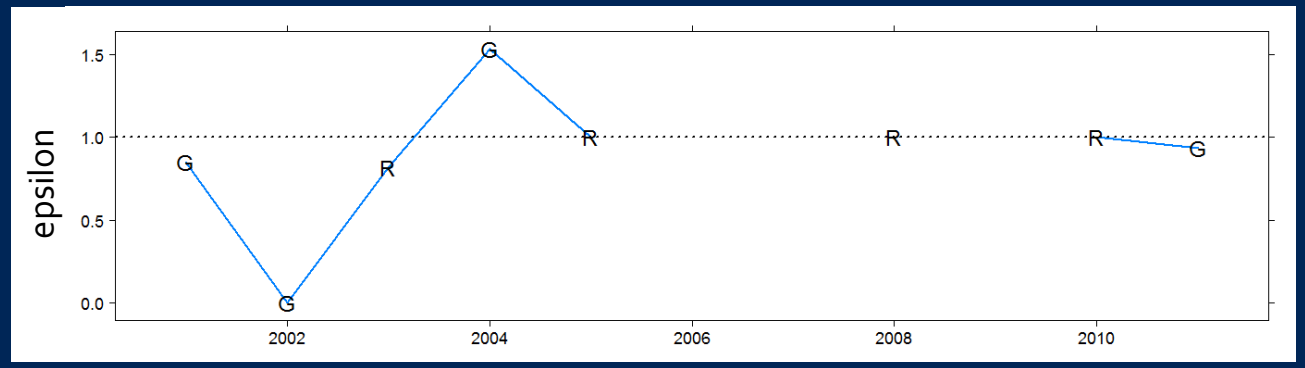
Retrospective analysis 3





Increase catch 1/8 yrs (zero false)
Neutral 3/8 yrs
Decrease catch 1/2 yrs (three false)

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Retrospective analysis 4

Scenario*	Total Catch (kt)	∑ [Catch × ε]	Delta
actual catches	284.5	267.7	-16.8
155 kt/season	1240.0	1105.5	-134.5
620 kt/season	4960.0	4422.1	-537.9

* over eight fishing seasons (2001-05, 2008, and 2010-11)

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Key features of AERD's FBM concept

- Synthesis of multiple data sets
- Adaptive to climate change, growing whale populations, etc.
- Synergy between ecosystem and single-species approaches
- Tactical decisions based on ecosystem data

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Relevance beyond Antarctica

- Fisheries that target forage species
  - total catch matters but where it's caught matters as much (more?)
  - decision rules based on ecosystem observations are adaptive to booms and busts in forage production (would need fisheries to adapt too)
- EBFM generally
  - ecosystem approaches are neither add-ons to nor replacements for single-species approaches – leverage the synergy
  - decision rules based on ecosystem observations transform the relevance of EBFM from strategic to tactical decision making

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STRENGTHS

- Great ideas that push boundaries of EBFM
- Ideas are transportable
- Great time-series data catalyze and support great ideas

CHALLENGES

- Complexity and using predator data tactically – difficult to build consensus
- No U.S. fishery
- Transporting our ideas
- Designing and implementing failsafes to loss of monitoring data

STRATEGIES

- Patience, persistence, and prescience
- Upwards and downwards adjustments
- Be at the edge and lead by example
- Develop approaches that are robust to loss of data (why allocation fractions are so important)

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